National Institute of Environmental Health Sciences

A new assessment of climate change impacts on food production shortfalls and water availability in Russia

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Abstract:

While previous studies have focused on impacts of average climate change on Russian agriculture and water resources, this study takes into account the impact of changing frequency and spatial heterogeneity of extreme climate events, and the reliance of most of Russia on a few food producing regions. We analyze impacts of the IPCC A2 and B2 climate scenarios with the use of the Global Assessment of Security (GLASS) model (containing the Global Agro-Ecological Zones (GAEZ) crop production model and the Water-Global Assessment and Prognosis (WaterGAP 2) water resources model). As in previous studies we find that decreased crop production in some Russian regions can be compensated by increased production in others resulting in relatively small average changes. However, a different perspective on future risk to agriculture is gained by taking into account a change in frequency of extreme climate events. Under climate normal conditions it is estimated that “food production shortfalls” (a year in which potential production of the most important crops in a region is below 50% of its average climate normal production, taking into account production in food-exporting regions) occur roughly 1–3 years in each decade. This frequency will double in many of the main crop growing areas in the 2020s, and triple in the 2070s. The effects of these shortfalls are likely to propagate throughout Russia because of the higher likelihood of shortfalls occurring in many crop export regions in the same year, and because of the dependence of most Russian regions on food imports from a relatively few main crop growing regions. We estimate that approximately 50 million people currently live in regions that experience one or more shortfalls each decade. This number may grow to 82–139 million in the 2070s. The assessment of climate impacts on water resources indicates an increase in average water availability in Russia, but also a significantly increased frequency of high runoff events in much of central Russia, and more frequent low runoff events in the already dry crop growing regions in the South. These results suggest that the increasing frequency of extreme climate events will pose an increasing threat to the security of Russia's food system and water resources.

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Resource Description

Climate Scenario :

specification of climate scenario (set of assumptions about future states related to climate)

Special Report on Emissions Scenarios (SRES)

Special Report on Emissions Scenarios (SRES) Scenario: SRES A2, SRES B2

Early Warning System:

resource focus on systems used to warn populations of high temperatures, extreme weather, or other elements of climate change to prevent harm to health

A focus of content

Exposure :

weather or climate related pathway by which climate change affects health

Extreme Weather Event, Food/Water Security, Food/Water Security

Extreme Weather Event: Other Extreme Event

Extreme Weather Event (other): Runoff events

Food/Water Security: Agricultural Productivity

Geographic Feature:

resource focuses on specific type of geography

None or Unspecified

Geographic Location:

resource focuses on specific location

Non-United States

Non-United States: Asia

Asian Region/Country: Other Asian Country

Other Asian Country: Russia

Health Impact:

specification of health effect or disease related to climate change exposure

Malnutrition/Undernutrition

Intervention:

strategy to prepare for or reduce the impact of climate change on health

A focus of content

Mitigation/Adaptation:

mitigation or adaptation strategy is a focus of resource

Adaptation

Model/Methodology:

type of model used or methodology development is a focus of resource

Exposure Change Prediction

Resource Type:

format or standard characteristic of resource

Research Article

Resilience:

capacity of an individual, community, or institution to dynamically and effectively respond or adapt to shifting climate impact circumstances while continuing to function

A focus of content

Socioeconomic Scenario: SES scenarios

Timescale:

time period studied

Long-Term (>50 years)

Vulnerability/Impact Assessment:

resource focus on process of identifying, quantifying, and prioritizing vulnerabilities in a system

A focus of content